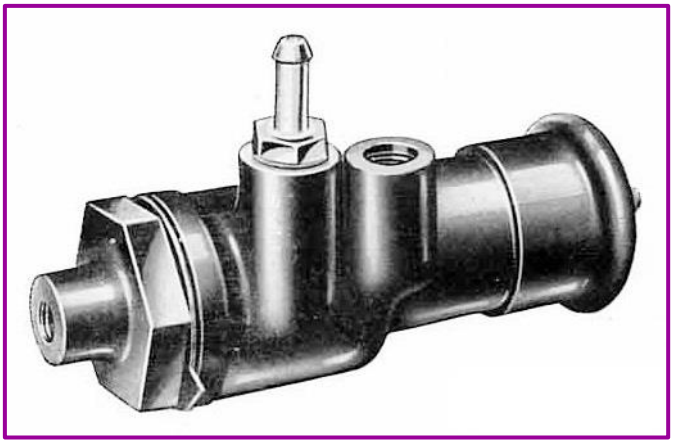
TECHNICAL NOTES SERIES

JOWETT JAVELIN – PA, PB, PC, PD & PE
JOWETT JUPITER – SA & SC



Upper, Jowett hydro-mechanical master cylinder. Lower, Jowett full-hydraulic master cylinder.

IMPORTANT: The Jowett hydraulic braking system master cylinders are of the pull type of assembly. They are located to the rear of the brake pedal pivot and, on the Javelin is attached to the right-hand side main body support structure; on the Jupiter the master cylinder is attached to fittings welded to the right-hand side main chassis tube.

These notes have been assembled in a format that, as much as possible, they assist those who have never attempted a Jowett master cylinder overhaul. They have been written to cater for younger Jowett Car Club members who may have limited mechanical knowledge.

It is necessary to understand that motor vehicle braking systems should not be modified in any way. The consequences of an accident caused by brake failure, due to modifications having been made to the vehicle's braking system, can have serious ramifications – particularly should a death be a result of an accident.

If a reader of these notes does not feel confident about the master cylinder overhaul procedures, then the master cylinder and associated new parts should be taken to a reputable brake specialist.

PART XLII – MASTER CYLINDER OVERHAUL

Compiled by Mike Allfrey – May, 2022.

CONTENTS

ACKNOWLEDGEMENTS

A large proportion of these notes have been sourced from Jowett Javelin and Jupiter Maintenance Manuals, along with service information issued for Jowetts by Girling Equipment, the manufacturers of the hydraulic braking systems as applied to the Javelin and Jupiter. Our thanks are accorded to Girling for the use of their information.

Our thanks are also due to Jowett enthusiasts Richard Homersham (JCCA), Jim Scott (JCCA) and Neil Moore (JCC NZ) for parts supply and the loan of a hydro-mechanical master cylinder for examination. Special thanks are due to Neil for providing a genuine full-hydraulic master cylinder for a Jowett, that has proved to be invaluable for the preparation for these notes. In addition to that, thanks are due to Keith Clements (JCC UK) for providing information, both published and from personal experience.

INTRODUCTION

The trigger for these Technical Notes was the brake locking at the offside rear wheel on my Jowett Jupiter, even though the car had been parked on a level garage floor, and with the handbrake not applied. In fact, the car was coasted into the garage, after its last road run, without the brakes being applied. The engine was run until the carburettors emptied and the car was left in gear, until the next exercise run during the ongoing COVID-19 lockdown duration.

It was suspected that, due to a number of significant and rapid temperature changes (plus changes in local humidity), that leakage of brake fluid at the right hand rear wheel cylinder had reached the brake lining material and, effectively, 'glued' the shoes to the brake drum. Thus making it appear that all four wheels had been locked. A strange situation occurred during a customary engine start and intention to take a short drive (5 km radius from home at the time) to help keep matters oiled and greased as and where they should be, in that there was no indication of lurching to the right as the clutch was engaged, due to the action of the rear axle differential. Hence the initial reasoning that all four wheels were locked and the master cylinder was initially thought to be the culprit.

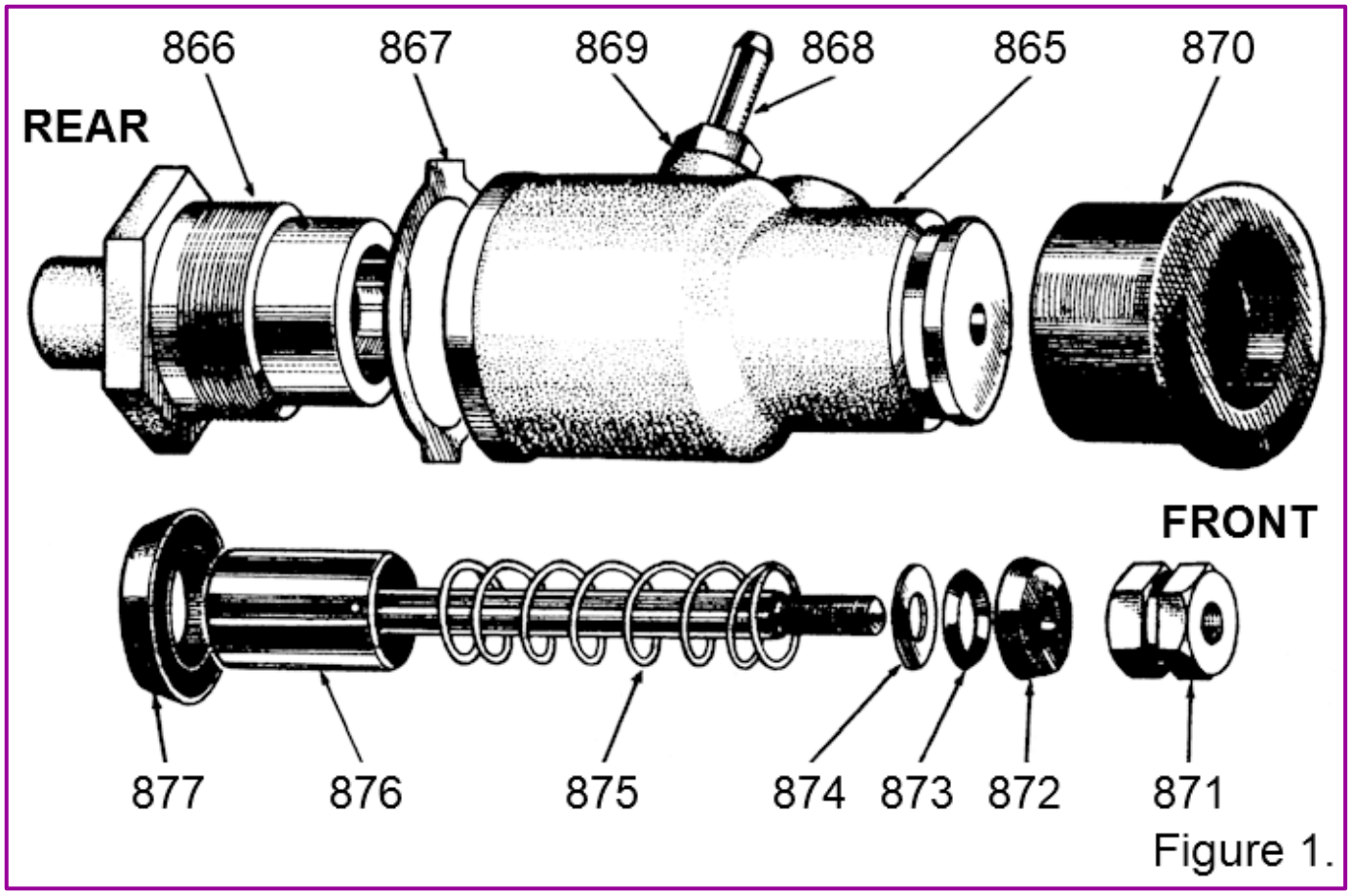
These notes have been assembled to assist those who are contemplating the overhaul of a Jowett braking system master cylinder, but have limited experience of undertaking such a task. The master cylinder is somewhat different from a 'normal' automotive master cylinder. It is known that certain Rover P3 and P4 models used similar types of master cylinder, Riley also used a pull type Girling master cylinder, therefore it is not uncommon. The reason the master cylinder is seen to be different is because it is of the pull type, not the push-the-plunger type.

There is minimal difference in the operating principles (see Pages 8 and 12) between the master cylinder for early Javelin/Jupiter models equipped with hydro-mechanical brakes, and the later full-hydraulic braking system master cylinder. The master cylinders for both hydro-mechanical and full-hydraulic types for Javelin and Jupiter models are the same. The seal kits and numerous parts for the two systems have different part numbers. Do not mix any of the components that may look similar when overhauling both types of master cylinder at the same time.

It is strongly advised that, when overhauling a Jowett full-hydraulic brake master cylinder, the front and rear bodies be considered to be a matched pair. If a braking system is being rebuilt from a mixed assortment of parts, then the master cylinder components should be carefully examined and dimensions of internal bores taken and written on a sheet of paper. In the event of anomalies being found, then those master cylinders will need to be identified and kept separate.

Refer to Page 11 for dimension differences that can be found.

DESCRIPTION OF THE PARTS – Hydro-Mechanical



Above: Figure 1. Illustration taken from the Spare Parts Catalogue, dated January, 1950.

Legend for *Figure 1*:

Item	Qty.	Part No.	Description
^*864	1	50428	Master Cylinder – Complete
*865	1	H-1495	Master Cylinder Body
*866	1	H-1476	Master Cylinder End Cap
*867	1	H-1481	End Cap Tab Washer
*868	1	H-1021	Inlet Union
*869	1	GB4731	Gasket – Inlet Union
*870	1	H-1498	Boot – Master Cylinder (Same As For Full-hydraulic Master Cylinder)
*871	1	H-1497	Lock Nut – Plunger ($^{5}/_{16}$-in. BSF Thread)
*872	1	H-1015	Seal – Outer (Same As For Full-hydraulic Master Cylinder)
*873	1	H-1485	Seal Spreader
*874	1	H-1480	Washer – Seal Spreader
*875	1	H-1753	Spring – Plunger Return
*876	1	H-1477	Plunger
*877	1	H-1145	Seal – Recuperating

* = Common To Early Jupiter; ^ = Not Illustrated. Note – all ‘H’ part numbers are of Girling origin.

DESCRIPTION OF THE PARTS – Full Hydraulic

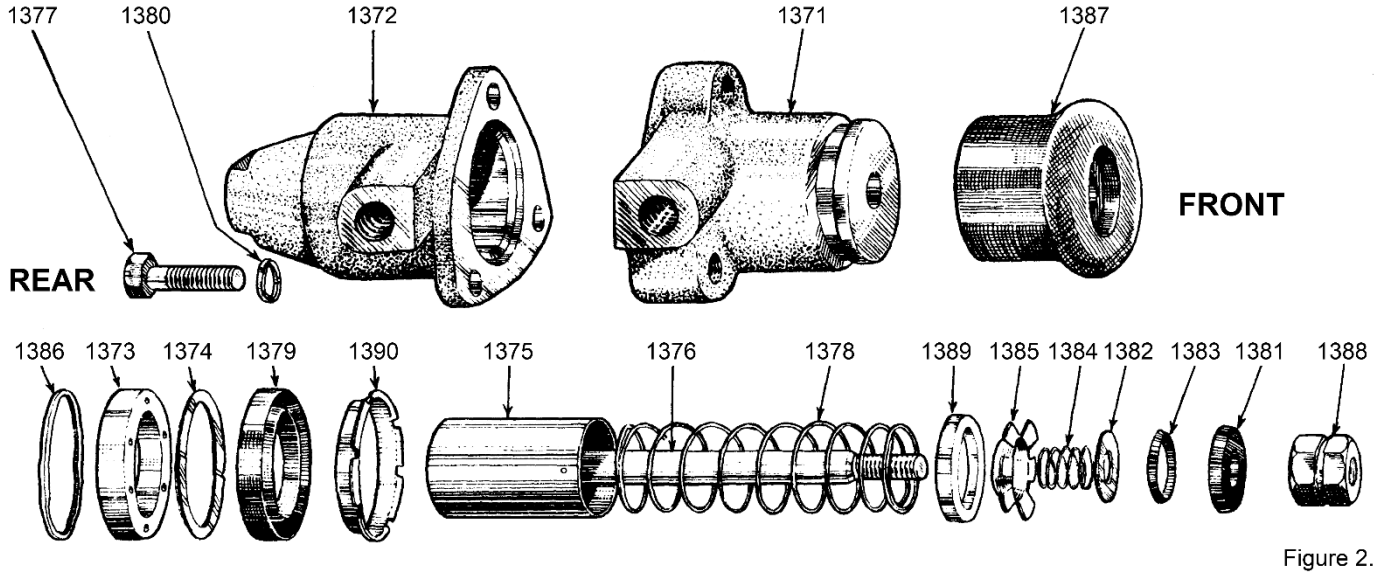


Figure 2.

Above: Figure 2. Illustration taken from the Spare Parts Catalogue, dated May, 1952.

Legend for *Figure 2*:

Item	Qty.	Part No.	Description
^*1370	1	54166	Master Cylinder – Complete
*1371	1	H-2714	Cylinder Body – Forward End (items 1371 and 1372 are a matched pair)
*1372	1	H-1817	Cylinder Body – Rear End
*1373	1	H-2715	Sleeve – Currently Available as PETP (Plastic)
*1374	1	H-2504	Shim
*1375	1	H-2586	Plunger – Outer Shell
*1376	1	H-2587	Rod, Plunger (Part of Plunger Assembly)
*1377	3	H-1927	Set Screw – Cylinder Assembly (Some are BSF, some are UNF)
*1378	1	H-1735	Spring – Plunger Return (Free Length 3·416-in. to 3·538-in.)
*1379	1	H-1016	Recuperating Seal
*1380	3	40-S-32	Spring Washer – $^{5}/_{16}$-in. Diameter
*1381	1	H-1015	Outer Seal
*1382	1	H-1480	Seal Retaining Washer
*1383	1	H-1483	Seal Spreader
*1384	1	H-1736	Seal Retaining Spring
*1385	1	H-1737	Spring Cover
*1386	1	H-1017	Sealing ‘O’ Ring
*1387	1	H-1498	Dust Cover
*1388	1	H-1497	Plunger Locknut ($^{5}/_{16}$-in. BSF Thread)
*1389	1	H-1925	Washer – Return Spring
*1390	1	H-2794	Spacing Washer
Item Descriptions Have Been Aligned With Those In Maintenance Manual			

* = Common To Jupiter; ^ = Not Illustrated. Note – all ‘H’ part numbers are of Girling origin.

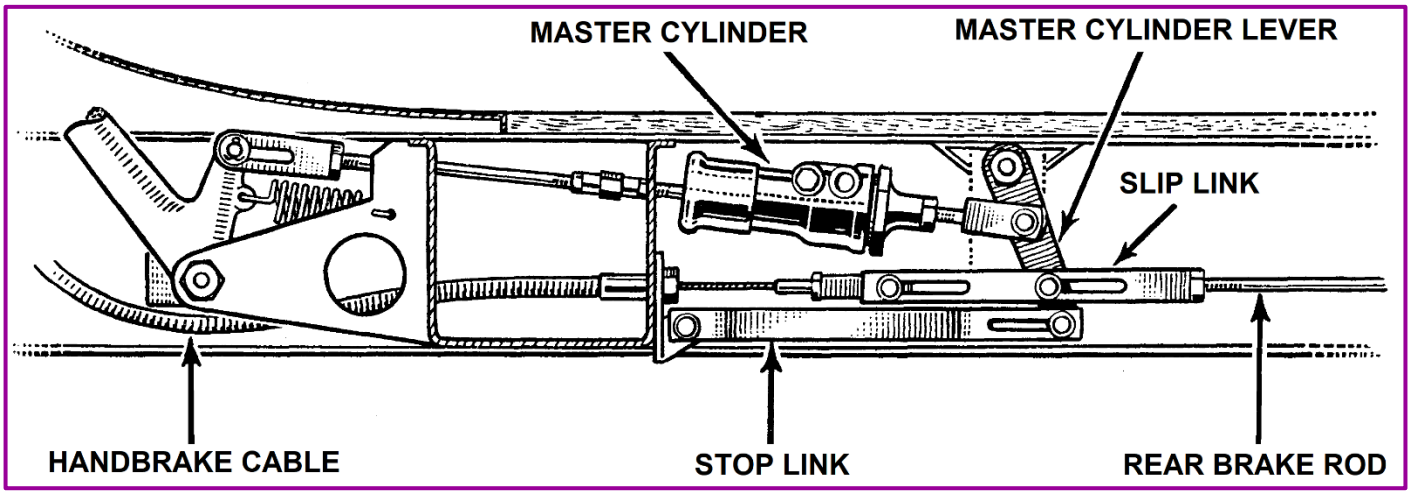
TO KEEP BRAKE FLUID IN THE HYDRAULIC SYSTEM

Should it be desirous to keep brake fluid in the fluid tank while servicing wheel cylinders, connect a tube to a bleed screw, with the free end in a clean container, and loosen off the bleed screw. Slowly press the brake pedal to its full travel, then tie or wedge the pedal in this position. The recuperating seal in the master cylinder will prevent drainage of fluid from the tank. If the master cylinder is to be removed, then the brake fluid should be drained at the inlet hose connection to the master cylinder.

Refer to Pages 7 and 10 for illustrated details.

THE HYDRO-MECHANICAL BRAKE MASTER CYLINDER LINKAGE

The hydro-mechanical brakes are designed so that should a failure of front or rear brakes occur, the pedal is not put out of action, and one of the systems will always be in operation. Should a failure occur in the hydraulic system the plunger in the master cylinder travels forward until it contacts the stop at the end of its stroke in the cylinder body. The cylinder is then, in effect, a solid unit and the remaining available pedal travel maintains mechanical operation of the rear brakes.



Above: Figure 3. Setting the brake slip linkage.

Note: *The Jupiter hydro-mechanical master cylinder lever pivots in a bushing welded into the right-hand chassis main tube. Otherwise the operation is the same as shown above.*

In the event of the failure of rear brakes, due to a broken or damaged rod or cable, the master cylinder lever contacts the front of the slot in the stop link, arresting any further forward movement of the cylinder body. The remaining pedal travel maintains the hydraulic operation of the front brakes. From this it will be readily understood that the correct setting of the brake slip linkage is especially important indeed. This setting should not normally be altered, as all adjustments should be made on the brake shoe adjusters, but if any doubt exists as to the accuracy of the setting, or if the slip linkage is to be reassembled the following points should be very carefully checked. Refer to *Figure 3*.

A. The clevis pin securing the master cylinder lever to the stop link must rest hard against the rear end of the slot in the stop link.

B. The master cylinder rod must be set so that the plunger is fully retracted, and the pedal arm has $^{3}/_{32}$-in. (2·5 mm.) free movement at the slotted fork.

C. With the brake shoes set correctly, and in the ‘off’ position, the rear brake rod must be adjusted so that the slip link clevis pin is hard against the front end of the rear slot in the slip link.

D. With the handbrake lever on the first notch of the ratchet plate, and the cable taut, the clevis pin connecting the cable to the slip link is hard against the front end of the slot.

E. When checking points ‘C’ and ‘D’ it is important that there should be no tension on the rear brake rod and rear compensator, and that the brake shoe expanders are fully closed.

TO REMOVE AND REPLACE MASTER CYLINDER (HYDRO-MECHANICAL)

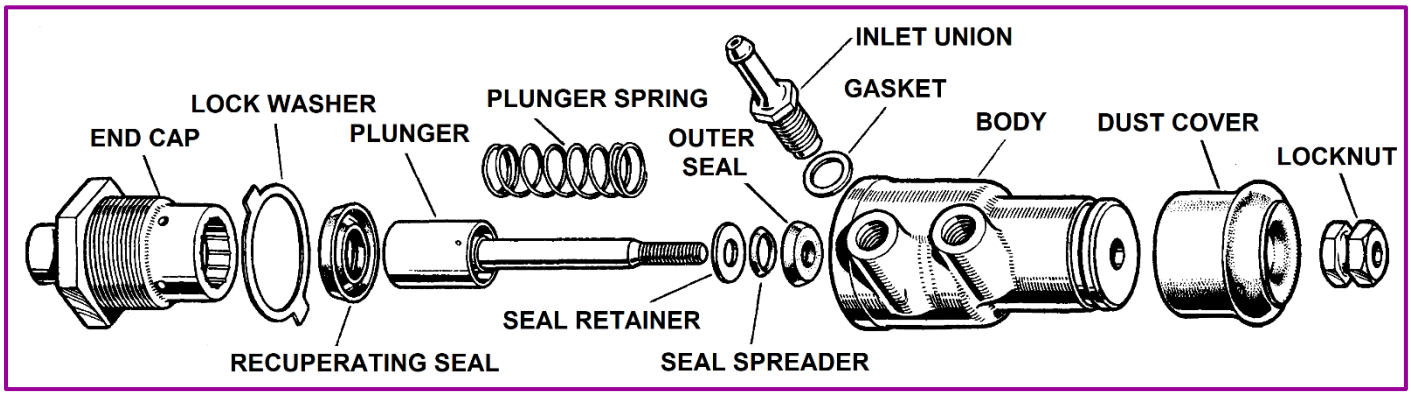
NOTE: The Jowett *Maintenance Manual* that covers the hydro-mechanical brake system has no information about removing and overhauling the master cylinder. Personally, I have not had any direct involvement with the hydro-mechanical braking system. The following text is purely from examining graphics in the manual and the spare parts catalogue – different procedures may apply.

Release the pedal return spring from the bracket supporting the brake pedal. Remove the clevis pin from the brake pedal. Disconnect low pressure hydraulic pipe at master cylinder body, and allow the fluid to drain off into a clean container. Unscrew the pressure hose to the three-way union at the master cylinder body.

Remove the clevis pin for the master cylinder at the master cylinder lever. Release the master cylinder locknut at the front of the master cylinder and unscrew the master cylinder from the rod. On Javelin, this may entail wriggling it from the box section. On Jupiter, the assembly is outboard of the right-hand side chassis main tube.

Replacement of the master cylinder is a reversal of the above procedure; the brake pedal should be adjusted after replacement of the master cylinder, as per the instructions provided at points A. to E. above. The master cylinder assembly will require being aligned to ensure that the fittings can be fitted easily. I do not know if the linkage components are identical for the Jupiter.

TO DISMANTLE THE MASTER CYLINDER (HYDRO-MECHANICAL)



Above: Figure 4. Exploded view of the hydro-mechanical master cylinder. Front of car is at right.

Bend back the tabs on the lock washer (*Item 867*) and securely grip the main body (*Item 865*) in a soft jaw vice so that the shoulder for the inlet union (*Item 868*) prevents the assembly from rotating while the end cap (*Item 866*) is unscrewed. When the end cap has been removed, the plunger (*Item 876*) will be exposed. Remove the rubber dust cover (*Item 870*) and, with the plunger pushed forward against its return spring (*Item 875*) the plunger rod should have two $^{5}/_{16}$-in. nuts locked together on the plunger rod thread. Hold one of these nuts with a spanner, so that the locknut (*Item 871*) can be loosened-off and, after removing the two nuts, the locknut can be unscrewed and placed in a suitable container. The locknut is unique in having a machined groove for the dust cover, it also has a counter-bore for the plunger rod shank. The plunger can then be extracted from the rear of the body and the return spring (*Item 875*), seal retainer washer (*Item 874*), seal spreader (*Item 873*) and the outer seal (*Item 872*) can be removed. The recuperating seal (*Item 877*) can be lifted out after the plunger has been pulled out. All parts should be washed with brake cleaning fluid (CRC Brākleen).

IMPORTANT! During reassembly of the master cylinder, all parts must be scrupulously clean and must be lubricated with brake fluid or a quality rubber grease (Penrite Red, castor oil based). Note that an overhauled master cylinder should be re-installed into the car with a minimum of delay, filled with fresh brake fluid and the system properly bled to expel air (and moisture) from the hydraulic system. Rubber grease does coagulate in the presence of air and this can affect the performance of the seals.

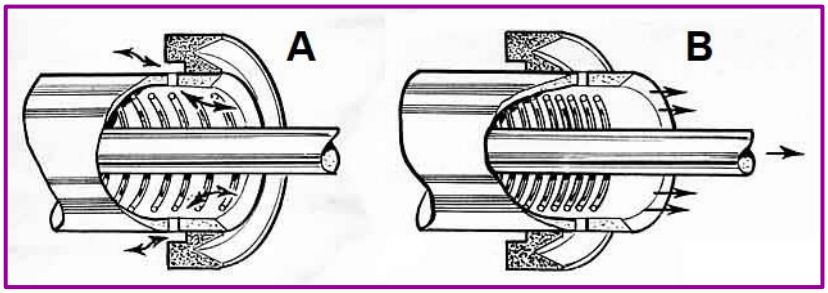
After compressed air drying, all parts should be inspected for wear and corrosion. In very humid conditions, moisture can be absorbed into the brake fluid and collect as droplets at the lowest points in the hydraulic system. Such droplets can cause serious corrosion that can affect the performance of the rubber seals. Refer to Appendix I, Page 20 for plunger inspection requirements.

It is strongly advised to carefully examine the piston for wear at its larger diameter, also, make sure that the small bleed holes are clear, and check the rod end where the outer seal has been active. The plunger rod should have no damage at the rod and must be a free sliding fit in the main body (*Item 865*) for its entire travel, a worn bore can be reclaimed by setting up the body in a lathe and increasing the size of the bore, part way, to accept a pressed-in bushing which can be reamed to size.

IMPORTANT! During reassembly of the master cylinder, all parts must be scrupulously clean and must be lubricated with brake fluid. All rubber parts can be lubricated with rubber grease to assist with assembly. Note that an overhauled master cylinder should be re-installed into the car, filled with fresh brake fluid and the system properly bled to expel air (and moisture) from the hydraulic system. Rubber grease does harden in the presence of air and this can affect the performance of the seals.

HOW THE HYDRO-MECHANICAL MASTER CYLINDER FUNCTIONS

The hydro-mechanical master cylinder is an early version of brake operation that is now taken for granted. Prior to the introduction of the hydro-mechanical brake system, hydraulic operation of motor car brakes was mostly used on luxury and high performance vehicles. Jowett brought the Girling hydraulic system to the family car, and, because of its novelty, many owners did not understand how the system operated. The Girling system is very simple in operation and, provided the correct parts are available, is easy to overhaul by a home mechanic, using up to date service information.



Right: Figure 5. 'A' shows that brake fluid can flow into and out of the master cylinder. 'B' shows that fluid can only be compressed as plunger moves forward.

The master cylinder body assembly consists of the forward end (*Item 865*), *Figure 1*, and the rearward end (*Item 866*) which, when assembled, feature two chambers containing brake fluid. When the brake pedal is in the home position, brake fluid is free to flow, *via* two bleed holes, as shown at '**A**' (*Figure 5.),* in the plunger (*Item 876*) into the area that becomes the pressure chamber as the plunger is moved forwards, shown at '**B**', (*Figure 5.),* the recuperating seal (*Item 877*) prevents the fluid from the reservoir entering the pressure chamber. Because the forward end of the body is fitted with an outer seal (*Item 872*), which also has the seal spreader (*Item 873*) and outer seal washer (*Item 874*) locating the plunger return spring (*Item 875*) applying a load against the outer seal assembly, ensures that as the brake pedal is pressed and so pulls the plunger rod forwards through the outer seal, this action compresses the brake fluid so that it is forced through the pressure port to the front wheel brake cylinders, which actuate the brake shoes.

NOTE: Because the brake fluid warms during braking, it expands and therefore is free to return to the supply tank. When the brake fluid cools, it replenishes the master cylinder.

During the compression of the brake fluid, the plunger pressurises the outer seal by hydraulic action against the outer seal washer and the seal spreader. This seal assembly is very important, due to the fact that if the seal spreader is not in position, brake fluid would leak past the seal's inner lip (between lip and rod) and outer lip (within the cylinder bore and past the outer seal), rather than actuate the wheel cylinders to apply the brakes. In an emergency stop, very high pressures can be generated – this can be as much as 2,000 psi (13,790 kPa), but normal heavy braking will generate 1,200 psi (8,274 kPa). These pressures denote that the correct outer seal assemblies be employed.

When the brake pedal is released, the plunger (*Item 876*) must be free to return to its home position. With this master cylinder, the plunger when moving to the home position, enters a close tolerance bore in the rearward body (*Item 866*), under pressure from the plunger return spring (*Item 875*), a relatively light spring, along with the brake pedal return spring, and assisted hydraulically by the brake shoe return springs. In a plain bore, the plunger would tend to become hydraulically loaded and resist return spring pressure until displaced fluid has leaked into the low pressure chamber. However, the bore in the end cap (*Item 866*) has controlled longitudinal leakage grooves broached into the bore diameter. These are not wear marks, they are intended to allow the plunger to return freely to the home position. Once home, brake fluid is free to bleed through the two small holes in the plunger and thus, replenish any fluid that may have been lost, due to possible leakage, during

the brake application. The end cap also has four bleed holes at the rear of its front shoulder to allow fluid from the supply tank to enter the low pressure chamber. The master cylinder is a precision item, due care should be given to ensure that it and all of its components do not suffer any damage.

As a footnote, because of the high pressures mentioned, it is important that brake pipes are free of rust, all pipe and cylinder threads must be in sound pressure withstanding condition and all copper washers be of correct specification.

TO REASSEMBLE THE MASTER CYLINDER (HYDRO-MECHANICAL)

A new, recently purchased master cylinder seal kit should be the only consideration to employ when reassembly commences. Rubber seals that have been in storage for a long time do harden and can be prone to immediate leakage. A driver's (or pedestrian's) life can depend on the seals used in a hydraulic braking system. Great care needs to be taken during reassembly, Penrite Red Rubber Grease, a castor oil based rubber grease, is recommended.

Grip, gently, the front master cylinder body (*Item 865*) in a soft jawed bench vice in a vertical position with the front face at the bottom. Lubricate the plunger rod and piston bores with fresh brake fluid.

First, insert the outer seal (*Item 872*), in its bore with its flat face towards the front of the master cylinder body (*Item 865*), making sure it is covered with a smear of rubber grease. Next, install the outer seal spreader (*Item 873*), with its angled face towards the outer seal, follow that with the outer seal washer (*Item 874*). As the brake pedal pulls the plunger (*Item 876*) forwards, a combination of added plunger spring (*Item 875*) loading and the increasing brake fluid pressure exert pressure on the seal spreader, forcing the outer lip against the bore in the body, and the inner lip around the diameter of the plunger rod. Make sure the outer seal retainer (*Item 874*) is on top of the seal spreader. Lower the plunger return spring (*Item 875*) into the front portion of the master cylinder body.

The lubricated recuperating seal (*Item 877*) can then be inserted with its open face towards the front of the master cylinder. Make sure that the outer lip of the seal does not twist as it is pushed home.

The lubricated plunger rod should be eased down through the front of the master cylinder body, so that the rod locknut (*Item 871*) can be threaded in place and then two nuts tightened together as described previously, so that the locknut, with counterbore towards the plunger rod shaft, can be tightened home. Remove the two nuts and, holding the plunger forward, thoroughly lubricate the shank with rubber grease. The rubber dust cover (*Item 870*) should be filled with rubber grease and secured with a Nylon tie strap at the body diameter. Ensure that the dust cover is properly seated in its groove in the locknut. Install the inlet union with a new gasket (copper washer – *Item 869*).

The end cap (*Item 866*) should be tightened home against a new tab washer (*Item 867*), which is a copper washer and should be used once only. The copper washer has two tabs, in this installation the tabs serve no purpose. After tightening dead tight, the purpose of the copper tab washer (*Item 867*) is to prevent leakage of brake fluid, which has self-migration properties. With the end cap in place, there should be a gap of ⅛ to 5/32 inch between the front face and the locknut. The plunger return spring should hold the plunger against the end cap when it is in the home position.

IMPORTANT! Only use genuine seals that are provided in the seal kit. Master cylinders have been dismantled and pieces of rubber hose have been found in place of the outer seal (*Item 872*). Such fitment is not at all a safe practice.

The master cylinder should be immediately installed in the car, using the set up instructions on Pages 5 and 6, and it must be installed so that the plunger is completely free to return to its home position, to ensure that the pressure chamber can be replenished with brake fluid. The brake hydraulic system should have all traces of air bled out, by commencing at the front wheel furthest from the master cylinder. Refer to Page 14 for the procedure for bleeding air from the hydraulic braking system.

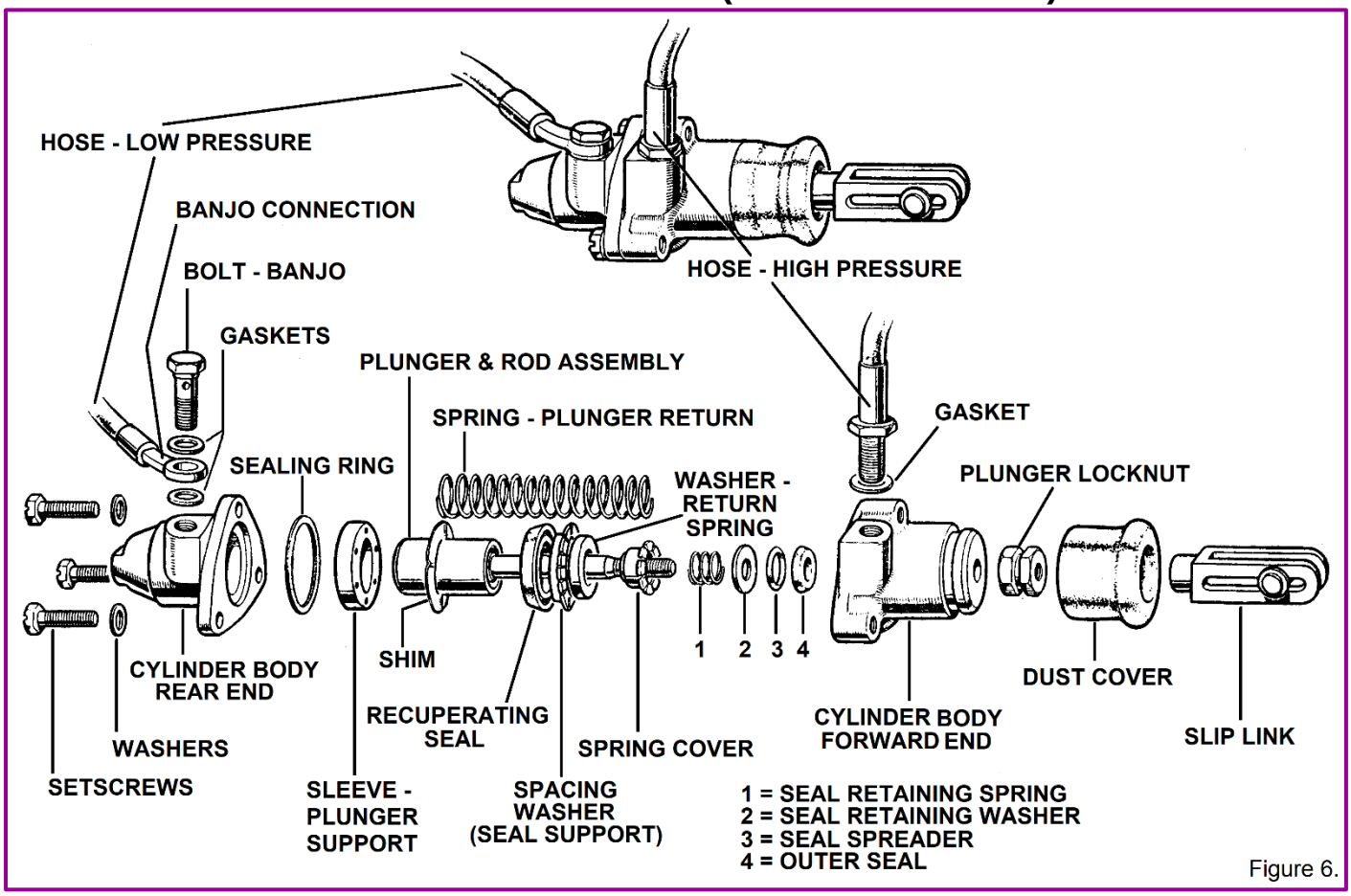
TO REMOVE AND REPLACE MASTER CYLINDER (FULL-HYDRAULIC)

Release the return spring from the master cylinder rod to tail (brake) light switch. Disconnect low pressure hydraulic pipe at master cylinder body, and allow the fluid to drain off into a clean container. Unscrew the pressure pipe to the four-way union at the master cylinder body.

Remove clevis pin at brake pedal so that the master cylinder fork is disconnected from the brake pedal. Release master cylinder rod lock nut and unscrew the rod so that it can be drawn forward through gearbox cross member. Unhook the brake pedal return spring. Remove the split pin and castle nut securing the master cylinder bolt eye to the chassis and withdraw the master cylinder.

Replacement of the master cylinder is a reversal of the above procedure; the brake pedal should be adjusted after replacement of the master cylinder.

TO DISMANTLE THE MASTER CYLINDER (FULL-HYDRAULIC)



Above: Figure 6. Exploded view of full-hydraulic master cylinder. Front of car is at right.

NOTE: Where possible, the front master cylinder body (*Item 1371*) and the rear master cylinder body (*Item 1372*) should be viewed as a matched pair. The reason for this observation being that the bores for the plunger support sleeve (*Item 1373*) will be the same, both dimensionally and for true central location within the three setscrew holes. This will greatly reduce the risk of the plunger (*Item 1375*) binding during its return to the home position – brakes completely off.

Drain residual brake fluid from both ports. Remove the slip link and rod, locknut and the dust cover (*Item 1387*), unscrew the three setscrews (*Item 1377*), securing the two halves of the body. Hold the plunger forwards against its return spring and, with two $^{5}/_{16}$-in. BSF nuts threaded onto the rod and tightened firmly against each other. Hold one nut with a spanner while the locknut (*Item 1388*) is loosened. Once loose, the two nuts can be removed and the locknut placed into a container. Remove the plunger assembly (*Item 1375*) complete with the return spring (*Item 1378*), then withdraw the sleeve (*Item 1373*) with the sealing ring (*Item 1386*), the steel shim (*Item 1374*), recuperating seal (*Item 1379*), seal spacing washer (*Item 1390*), return spring washer (*Item 1389*), spring cover (*Item 1385*), seal retaining spring (*Item 1384*) and finally the seal retaining washer (*Item 1382*) and seal spreader (*Item 1383*) together with the outer seal (*Item 1381*), refer to *Figures 2* and *6*.

Clean all parts with brake cleaning fluid (CRC Brākleen NF) and, after compressed air drying, all parts should be inspected for wear and/or corrosion. In humid conditions, moisture can be absorbed into the brake fluid through the supply tank vent and collect as droplets at the lowest points in the

hydraulic system. Such droplets can cause serious corrosion that can affect the performance of the rubber seals. Make sure that the shim (*Item 1374*) has not broken at one of the dimples.

It is strongly advised to carefully examine the piston for wear at its larger diameter, also, make sure that the small bleed holes are clear, and check the rod end where the outer seal has been active. New stainless steel plunger assemblies are available from JCCA spare parts stock. The plunger rod should be a free sliding fit in the cylinder body, forward end (*Item 1371*), a worn bore can be repaired by setting up the body in a lathe and increasing the size of the bore, part way, to accept a pressed-in bushing which can be reamed to size. The sleeve (*Item 1373*) can wear at its inside diameter.

Refer to Appendix I, Page 19 for plunger inspection requirements.

IMPORTANT! During reassembly of the master cylinder, all parts must be scrupulously clean and must be lubricated with brake fluid or a quality rubber grease (Penrite Red, castor oil based). Note that an overhauled master cylinder should be re-installed into the car with a minimum of delay, filled with fresh brake fluid and the system properly bled to expel air (and moisture) from the hydraulic system. Rubber grease does coagulate in the presence of air and this can affect the performance of the seals.

INSPECTION OF FULL-HYDRAULIC MASTER CYLINDER BODIES

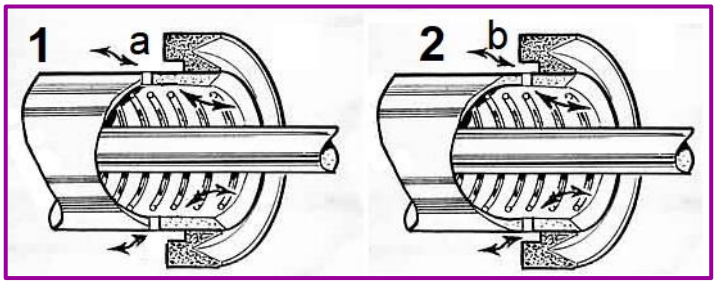
Should there be any element of doubt about the master cylinder being a genuine Jowett component, it is advisable to check the dimensions in the table below:

Dimension Taken	Genuine	Non-Genuine
Front Body Dimensions:		
Joint Face to Support Sleeve Ledge*	0·250-in.	0·250-in.
Bore Diameter For Sleeve – Front Body	1·4945-in.	1·498-in.
Joint Face to Ledge for Recuperating Seal Washer/Seal	0·568-in.	0·509-in.
Plunger Return Spring – Free Length	3·416-in.	3·538-in.
Rear Body Dimensions:		
Joint Face to Support Sleeve Ledge*	0·108-in.	0·098-in.
Bore Diameter For Sleeve – Rear Body	1·500-in.	1·4935-in.
Plunger Return Bore Depth – From Joint Face	1·037-in.	1·083-in.
Total Recess For Support Sleeve – Bolted Together	0·358-in.	0·348-in.
Master Cylinder Bodies – Overall Length (Bolted Together)	2·256-in.	2·264-in.

* This was the only dimension that was common.

CONSEQUENCES OF NON-GENUINE MASTER CYLINDER BODY SET

Shown in *Figure 7* is the difference that can be made when the master cylinder plunger is able to travel further rearwards to its home position.

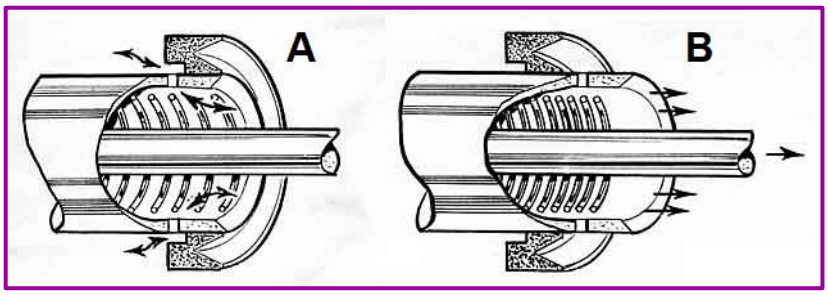


Right: Figure 7. Showing the plunger in its home position. 1= Non-Genuine; 2 = Genuine.

Referring to *Figure 7*, the plunger is shown with fluid bleed holes at ‘a’, further away from the rear face of the recuperating seal. As can be seen at left, the genuine plunger in a non-genuine master cylinder has to travel further before the recuperating seal can close-off flow from or to the reservoir (tank) and begin compressing brake fluid to actuate the brakes. At right, a genuine plunger in a genuine master cylinder, ‘b’ illustrates a significantly shorter distance of plunger travel before the fluid bleed holes are closed-off by the recuperating seal and compression of brake fluid can commence. Item 1 clearly illustrates how brake pedal travel is increased. This sketch is not to scale and is purely diagrammatic.

HOW THE FULL-HYDRAULIC MASTER CYLINDER FUNCTIONS

The master cylinder is an improved, higher capacity, version of the hydro-mechanical type and it has greater hydraulic effort due to extra wheel cylinders in the braking system. Jowett brought the uprated Girling system to the Javelin and Jupiter in September, 1950 (Engine No. E0 PB 10594). Because of its supposed complexity, many owners did not understand how the system operated. The Girling system is very simple in operation and, provided the correct parts are available, is easy to overhaul by a home mechanic, using up to date service information.



Right: Figure 8. 'A' shows that brake fluid can flow into and out of the master cylinder. 'B' shows that fluid can only be compressed as plunger moves forward.

The master cylinder body assembly consists of the forward end (*Item 1371*), *Figure 2*, and the rearward end (*Item 1372*) which, when assembled features two chambers containing brake fluid. When the brake pedal is in the home position, brake fluid is free to flow, *via* two bleed holes in the plunger (*Item 1375*), shown at '**A**' (*Figure 7*), into the area that becomes the pressure chamber as the plunger is moved forwards, the recuperating seal (*Item 1379*) prevents the fluid from the reservoir entering the pressure chamber, shown at '**B**' (*Figure 7)*. Because the forward end of the body is fitted with an outer seal (*Item 1381*) which also has the seal spreader (*Item 1383*), outer seal washer (*Item 1382*), seal retaining spring (*Item 1384*) and the spring cover (*Item 1385*) locating the plunger return spring (*Item 1378*), applying a load against the outer seal assembly, ensures that as the brake pedal is pressed and thus pulls the plunger rod forwards through the outer seal, this action compresses the brake fluid so that it is forced through the pressure port to the wheel brake hydraulic cylinders, which actuate the brake shoes.

NOTE: Because the brake fluid warms during braking, it expands and therefore is free to return to the supply tank. When the brake fluid cools, it replenishes both master cylinder fluid chambers.

During the compression of the brake fluid, the plunger pressurises the outer seal by hydraulic action against the outer seal washer and the seal spreader. This seal assembly is very important, due to the fact that if the seal spreader is not in position, brake fluid would leak past the seal's inner lip (between lip and rod) and outer lip (within the cylinder bore and past the outer seal), rather than actuate the wheel cylinders to apply the brakes. In an emergency stop, very high pressures can be generated – this can be as much as 2,000 psi (13,790 kPa), but normal heavy braking will generate 1,200 psi (8,274 kPa). These pressures denote that the correct outer seal assemblies be employed.

When the brake pedal is released, the plunger (*Item 1375*) must be free to return to its home position. With this master cylinder, the plunger when in the home position, it is supported by the aluminium sleeve (*Item 1373*), which is drilled to allow fluid to flow from the supply tank into the pressure chamber, and enters the the rear end (*Item 1372*) low pressure chamber. The plunger returns under force exerted by the plunger return spring (*Item 1378*), a relatively light spring, assisted by the brake pedal return spring and by hydraulic action from the brake shoe return springs. Once home, brake fluid is free to bleed through the drillings in the aluminium sleeve and the plunger and thus, replenish any fluid that may have been lost, due to possible leakage, during the brake application.

The master cylinder is a precision item, due care should be given to ensure that it and all of its components do not suffer any damage. Due to the high pressures mentioned, it is important that brake pipes are free of rust, all pipe and cylinder threads must be in sound pressure withstanding condition, the flexible hoses and all copper washers be of correct specification and in good condition.

JOWETT FULL-HYDRAULIC MASTER CYLINDERS – BE AWARE!

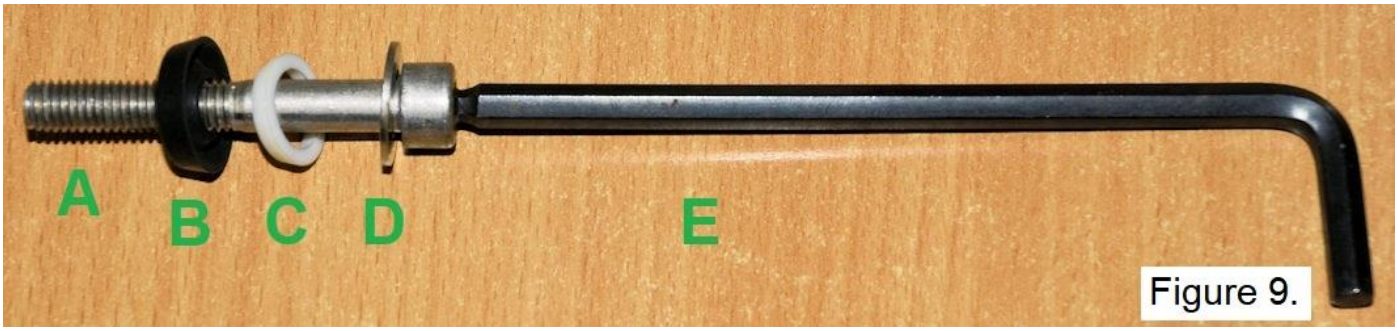
Should full-hydraulic master cylinders, either used or new old stock, be found at a swap meet, make sure that they match the specification of the Jowett type. This is not at all easy to establish from a visual aspect. However, if the rubber dust cover (*Item 1387*) can be easily removed, then there should be the gap as described at Step 14. on Page 12. The only other method is to check the depth

of the plunger return bore in the rear body, which for the Jowett master cylinder should be 1·037-in. Should the bore be deeper, from the joint face – the master cylinder is not a genuine Jowett unit.

The consequence of using an incorrect master cylinder assembly can be longer brake pedal travel and, possibly, difficulty bleeding the hydraulic system. This has been borne out by experience.

TO RE-ASSEMBLE THE MASTER CYLINDER (FULL-HYDRAULIC)

After thoroughly cleaning all parts with brake fluid or brake cleaning fluid and after blow drying with compressed air, apply a smear of rubber grease to all rubber components. The internal bores in the housing should show no sign of corrosion. The mating faces of the front and rear cylinder ends must be absolutely flat and free of corrosion. Lubricate the bores with clean brake fluid or rubber grease and, once the outer seal assembly has been installed, secure the forward end of the cylinder body (*Item 1371*) so that it is vertical in a bench vice with soft jaws. The following stages will assist with the installation of the master cylinder components:



*Above: Figure 9. Legend: '**A**' cap screw, '**B**' outer seal, '**C**' seal spreader, '**D**' washer and '**E**' the Allen key.*

1. To assist installation of the outer seal (*Item 1381*) into the forward end body, slide the seal, the spreader (*Item 1383*), with tapered face towards the outer seal's cup, and the spreader washer (*Item 1382*) onto an 8 mm x 60 mm (or similar) in-hex head Allen screw with the screw's head against the spreader washer. Insert this assembly into the lubricated master cylinder body and gently push the outer seal assembly into its home position with the key.
2. Ensure that the bore for the plunger rod (*Item 1376*) in the front end of the master cylinder body is lubricated with rubber grease.
3. Mount the master cylinder front body vertically (front end down) in a soft jawed vice. Install the outer seal spring (*Item 1384*), spring retainer (*Item 1385*), plunger return spring washer (*Item 1389*), plunger return spring (*Item 1378*) into the body, while held vertical in the vice.
4. With these components carefully installed in the forward half of the master cylinder body, place the recuperating seal support washer (*Item 1390*) on its ledge in the body, with its cone upwards. Lubricate the recuperating seal with rubber grease and ease it gently into the bore in the body.
5. It is advisable to freely lubricate the plunger/rod assembly prior to installing it into the body.
6. Place the shim (*Item 1374*), with the raised indentations facing the recuperating seal, on top of the seal. As the plunger is eased into the recuperating seal (*Item 1379*), recuperating seal support washer (*Item 1390*), and the plunger rod is eased through the plunger return spring (*Item 1378*), return spring washer (*Item 1389*), spring retainer (*Item 1385*), outer seal spring (*Item 1384*), washer (*Item 1382*), outer seal spreader (*Item 1383*) and outer seal (*Item 1381*), gently push the plunger assembly, guiding it carefully into the outer seal, to its most forward position against the return spring and hold it in that position.
7. Thread the plunger locknut (*Item 1388*) all the way onto the plunger rod, with the counterbore towards the rod shank.
8. Ensuring that the recuperating seal and shim stay in their positions in the front body, gently release the plunger towards its home position, and then insert the lubricated plunger support sleeve (*Item 1373*), preferably a new sleeve, its grooved face uppermost, into the body.
9. At the threaded end of the plunger rod, screw on two $^{5}/_{16}$-in. BSF nuts, one thin and the other a standard nut, and tighten securely against each other.

10. Holding the inner nut with a spanner, tighten firmly the plunger locknut against the rod shank taper. The two slave nuts can then be removed.
11. Ensure that there is rubber grease between the locknut and the master cylinder front body.
12. In a bench vice with soft jaws, grip the locknut so that the master cylinder body is vertical. Install the sealing ring (*Item 1386*) over the protruding plunger support sleeve (*Item 1373*). Apply a light smear of rubber grease at the joint face.
13. Install the rear master cylinder body (*Item 1372*) so that the inlet port aligns with the pressure port at the front master cylinder body.
14. Mount the front master cylinder body in a bench vice with soft jaws to hold it firmly while the setscrews are fully tightened. After the two bodies have been bolted together, there should be ⅛ to $^{5}/_{32}$-inch (3·17 to 3·96 mm) gap between the locknut and the body front face.
15. The three setscrews that secure the two halves of the master cylinder are $^{5}/_{16}$-in. UNF or BSF x 1-in. long. Because of limited room for the heads of the setscrews (*Item 1377*), they are furnished with screwdriver slots. Apply a smear of Penrite Copper Eze at the threads and gently tighten the three screws. Use new spring washers with the screws. An alternative is to install three in-hex Allen cap screws so that they can be conveniently tightened using an Allen key.

    Should the original screwdriver setscrews be re-used and tightened with a screwdriver, then a square shank screwdriver and suitable spanner should be employed to fully tighten.

    WARNING! Due to machining tolerance anomalies, after assembly of the two master cylinder bodies, check for a binding condition at the master cylinder plunger assembly. The rear body (*Item 1372*) is located concentrically over the sleeve which protrudes beyond the rear face of the front body (*Item 1371*). During the installation of the three setscrews (*Item 1377*), each setscrew should thread into the front body freely, if a setscrew is 'loaded' towards one side, this situation could indicate that the two bodies are not an original matched pair.

    After tightening the three setscrews (*Item 1377*), the plunger and rod assembly must be of a free sliding fit in the recuperating seal (*Item 1379*) and the support sleeve (*Item 1373*) so that the return spring (*Item 1378*) returns the assembly to the home (brakes off) position without assistance. In the home position, the plunger must be free to make contact inside the rear body.

    The warning above is of utmost importance, if the plunger and rod assembly cannot return to the home position, the hydraulic brakes can be partially applied and generate heat. When such a condition exists, the next application of the braking system can result in loss of stopping power. The external brake pedal return spring is included solely to hold the brake pedal in its non-applied position, not to return the plunger and rod assembly to its home position.
16. Invert the master cylinder assembly in the vice. Apply a copious amount of rubber grease around the locknut and front face of the master cylinder body.
17. Part-fill the rubber bellows (*Item 1387*) with rubber grease, then push bellows into the groove in the lock nut, and further on over the master cylinder body and into its groove. Use the supplied Nylon cable tie to secure in place. The master cylinder is now assembled.
18. Assemble the slip link and rod onto the plunger rod (*Item 1376*) and tighten securely against the locknut. After the master cylinder is installed in the vehicle, the slip link, where it connects to the brake pedal, should be adjusted to provide 0·03125-in. (0·790 mm) clearance at the pin with the plunger and rod assembly in its home position.
19. The copper washers (gaskets) at the fluid inlet fitting and the pressure outlet banjo bolt should be renewed.
20. Apply Penrite Copper Eze at the pipe threads to facilitate their removal later, this also applies to the wheel cylinders, brake pipe and flexible hose fittings.

NOTE: When the master cylinder has been assembled it should be immediately installed in the car, adjusted and, after the pipes have been installed, the reservoir filled with fresh brake fluid and the hydraulic system bled right through, the reservoir should be kept topped-up at all times. Leaving the system 'dry' for a lengthy period will allow the rubber grease to dry and the rubbers will then become less flexible, such a condition can make it virtually impossible to bleed all air from the system.

IMPORTANT! During installation of the master cylinder into the vehicle, the eye bolt threaded and locked tightly into the rear body (*Item 1372*), must be set so that the eye of the bolt aligns with the pivot mounted on the chassis structure. The master cylinder assembly, after mounting on the pivot must also align perfectly with the clevis pin arm on the brake pedal. After installation, the eye bolt must be free to allow the master cylinder to pivot as the brake pedal moves through its arc. This movement is minimal but necessary to allow free return movement of the plunger to its full home position without any restriction. Pivot movement is minimal, but is essential. The eye bolt should be lubricated with zinc oxide white grease and the freedom to pivot checked frequently.

The reason for this requirement is that, should the plunger not return freely to its home position, then brake fluid will not be able to flow from the supply tank and replenish the pressure chamber. In the event of wheel cylinder seal or hydraulic fitting leakage, brake fluid lost will eventually cause total brake failure, due to brake fluid not being replenished because the plunger cannot return fully to its home position. Such a condition, particularly due to the wheel cylinder seals hardening and leaking, can arise when a vehicle is not used frequently.

MASTER CYLINDER PLUNGER NOTES

For both types of hydraulic system the plungers (*Items 875 & 1375*) are, basically similar. The shell diameter of the plunger in the hydro-mechanical hydraulic system is smaller than that in the full-hydraulic system. The originals were chrome plated to provide a smooth surface for the recuperating seals (*Items 877 & 1379*) and the rod end outer seals (*Items 872, 873, 1381 & 1383*). The current replacements are stainless steel with finely ground surfaces, which with proper maintenance, should last for many years and outlive many seal kits.

Of particular note is the fact that the plating on an original plunger and rod can be affected by corrosion due to water droplets that can mix with the brake fluid. Such corrosion can affect the seals and, in the case of the full-hydraulic system, can cause wear at the aluminium (or PETP) sleeve (*Item 1373*). It should be noted that the sleeve is the rear support for the plunger and wear at the inner diameter can affect the sealing properties of the recuperating seal. The prime symptom of this condition would be an initial soft feel at the brake pedal when applying the brakes.

A corroded plunger in a hydro-mechanical system could score the bore in the end cap (*Item 866*) and cause support concerns for the recuperating seal.

The Jowett manuals do not state a time or mileage interval for replacing the master cylinder and wheel cylinder seals, therefore with a vehicle that is used infrequently, it is probably worthwhile replacing all hydraulic system seals every five years, and flushing the system every two years. Recently, while in discussion with a local brake service centre, there was an expression of surprise when the shop manager was told that the leaking wheel cylinder seals had been replaced seven years previously. He expected the seals to be renewed more frequently.

With the Jowett Car Club of Australia having new-manufacture universal brake drum pullers in stock, at a very reasonable price, it is now possible to engage in a regular maintenance programme with great ease and convenience.

TO BLEED AIR FROM THE HYDRAULIC SYSTEM

This action is necessary if any air has been allowed to enter the system. Top-up the fluid reservoir, remove the rubber cap from the left hand rear brake bleed nipple, fit a bleed tube over the nipple and immerse the free end in a clean glass jar containing a little Penrite Brake D.O.T-4 fluid. Unscrew the bleed nipple about three quarters of a turn, then operate the brake pedal with full slow strokes until the fluid enters the jar completely free of air bubbles. Then, during a downward stroke of the brake pedal tighten the bleed nipple; no excessive force should be used when tightening the bleed screw. This procedure should be conducted at every brake, finishing at the wheel nearest the master cylinder. It is most important when conducting the bleeding operation to keep the fluid reservoir topped-up otherwise air will enter the master cylinder. Never use the fluid which has just been removed from the system until it has been allowed to stand for at least 24 hours.

Keeping Brake Fluid In The Supply Tank – For both hydraulic systems, when working only on wheel cylinders or the high pressure pipes and hoses, brake fluid can be kept in the supply tank by holding the brake pedal fully down, with a suitable block of wood, as the applicable bleed screw (with bleeder tube attached) is released. Taking this action prevents the head of brake fluid from migrating through the two small holes in the plunger piston shell. Should it be required to empty the supply tank, the pedal will need to be slowly pressed repeatedly, until the supply tank has been emptied.

NOTE: Early style bleed nipples seated on a small steel ball in the aluminium (also cast iron) wheel cylinders. In those instances where the bleed nipple has been over-tightened, the steel ball can wedge inside the wheel cylinder. Mostly, the ball can be dislodged by a rapid pressing of the brake pedal to generate sufficient pressure to release the stuck ball. Leave the nipple loose so that the ball does not get ejected and lost. In severe cases, the wheel cylinder will need to be replaced, or reconditioned by a brake specialist.

BRAKE FLUIDS

The shelves in automotive parts stores contain numerous types of brake fluid. For the Jowett braking system it may be customary to select a good quality DOT-4 fluid, such as Penrite Super Brake Fluid. Here are some specifications for brake fluids that are available:

- **DOT-3:** Brake fluid has a dry boiling point of 205 °C and a wet boiling point is 140 °C.
- **DOT-4:** Brake fluid has a dry boiling point of 230 °C and a wet boiling point of 155 °C.
- **DOT-5**: Silicone brake fluid has a dry boiling point of 260 °C and a wet boiling point of 180 °C.
- **DOT-5·1**: Brake fluid has a dry boiling point of 270 °C and a wet boiling point of 180 °C.

When the brake pedal is pressed and creates friction between brake linings and drums that stop the vehicle, it creates heat that is transferred to the fluid *via* the wheel cylinders. It is doubtful that great heat, unless descending mountain roads with frequent heavy brake applications, reaches the brake master cylinder in a Jowett. Different brake fluids react to heat in different ways which is why there are the different types of brake fluid specified by vehicle manufacturers, as described above, are available. These are generally differentiated by the term DOT. The letters DOT stand for Department of Transportation (USA). It is the Department of Transportation that sets the regulations and safety standards that brake fluid has to meet. The brake fluids are given a number rating such as DOT-2, DOT-3, DOT-4, DOT-5 or DOT-5·1. DOT-2 may well be equivalent to the original Girling (Wakefield) crimson brake fluid specified by Jowett Cars Limited.

Used in a Jowett's brake system, DOT-3 fluid should cope easily with the temperatures generated during normal road use. However, the DOT-3 and 4 fluids are hygroscopic, meaning that the fluid can absorb moisture (water) and, for motor cars that are used infrequently this, under certain conditions can be a concern. The Jowett brake system uses a vented supply tank that, under humid conditions can let moisture into the brake hydraulic system. Modern master cylinder tanks have a collapsible rubber diaphragm that seals the tank lid from any moisture in the atmosphere – as brake fluid exits and returns, the rubber is pliable enough to cope with the amount of fluid movement. With the freely vented supply tank, moisture absorbed will, eventually, collect at lowest points in the hydraulic system, namely at the master cylinder and the wheel cylinders and can cause corrosion, leading to damaged and leaking seals.

This is not the only way water is absorbed into the system.

Research has revealed that brake hose materials cannot seal out water molecules, which are some of the smallest in nature. The molecules can penetrate through the hose walls because of vapour pressure being higher on the outside in humid weather. With DOT-5 silicone fluid not being able to absorb the water vapour, therefore the water collects at the lowest points. That can lead to boiling during heavy braking, because unlike DOT-3 and 4, the water is not mixed with the DOT-5 which means its boiling point can be rather low. If it boils into steam it greatly expands. It not only causes rust/corrosion, water can freeze in winter (readers in other countries, note). Frozen water being forced through the hydraulic system may cause troubles when the brakes are applied.

If DOT-5 is used in a Jowett do not assume it is suitable for life. Such an assumption, that you never have to inspect inside the brake system, or flush with new DOT-5 every few years, is a delusion.

There is also the option of using a silicone-based fluid, should such be selected, then *all* components that make up the hydraulic system must be thoroughly cleaned and *all* rubber parts must be renewed. Silicone brake fluid and other brake fluids are not compatible. The decision is entirely that of the overhauler of the master cylinder.

DOT-3 Penrite Brake Fluid

DOT-3 is a premium quality, non-silicone, non-mineral/petroleum based, fully synthetic brake fluid designed for use in a wide range of brake and clutch applications.

This brake fluid is recommended for re-fill or top-up of brake and clutch systems in passenger cars, that require a non-petroleum based DOT-3 brake and clutch hydraulic fluid.

DOT-3 brake fluid can be used for first fill or refilling a brake or clutch system. For best results, the system should always be flushed with Penrite brake fluid DOT-3 prior to first fill or before refilling the system.

Excellent braking response due to the high boiling point of the fluid. High wet boiling point ensures long term retention of the fluid performance. Compatible with all common brake system materials.

DOT-3 brake fluid should be changed according to the manufacturers service specifications.

NOTE: Do not mix this product with Silicone DOT-5 or Mineral type brake fluids.

DOT-4 Penrite Super Brake Fluid

Penrite Super DOT-4 brake fluid is a premium quality, non-silicone, non-mineral/petroleum based, fully synthetic brake fluid designed for use in a wide range of brake and clutch applications. Typical dry boiling point 275 °C, wet boiling point 183 °C. Super DOT-4 brake fluid is recommended for re-fill or top-up of brake and clutch systems in passenger cars and other vehicles that require a non-petroleum based DOT-3, DOT-4 or Super DOT-4 brake and clutch hydraulic fluid. Super DOT-4 brake fluid is suitable for use where the vehicle manufacturer specifies DOT-3 or DOT-4 brake fluid. Super DOT-4 brake fluid should be changed according to the manufacturer's service specifications.

Penrite Super DOT-4 brake fluid can be used for first fill or refilling a brake or clutch system. For best results, the system should always be flushed with Penrite Brake Fluid Super DOT-4 prior to first fill or before refilling the system.

IMPORTANT: Do not mix this product with Silicone DOT-5 or Mineral type brake fluids. Not mixable with Silicone type assembly compounds. Avoid contact with skin, varnish and paint. If skin contact occurs wash with water.

Non-silicone brake fluids are naturally hygroscopic and will absorb water from the air. This will lower the effectiveness of the product. After opening bottle, ensure cap is resealed tightly immediately to avoid water contamination.

Benefits – Excellent braking response due to high boiling point of fluid. High wet boiling point ensures long term retention of fluid performance. Better performance for life of fluid compared to DOT-3 fluids. Compatible with all common brake system materials. Compatible with DOT-3 and DOT-5·1 (low temperature, non-silicone type).

Compatible with DOT-3 and DOT-5·1 (**low temperature non-silicone type**).

Penrite DOT-5 Silicone Brake Fluid

Silicone brake fluid is recommended for re-fill or top-up of brake and clutch systems in all vehicles and equipment that specify a DOT-5 Silicone fluid. It can be used for first fill or refilling system that already contains DOT-5 brake fluid. It is suitable for use in racing cars and motorcycles for competition applications as it resists the formation of vapours that can cause a loss in braking performance. It has an extremely high boiling point (>300 °C), providing good pedal feel and fade free braking. It is not hygroscopic so will not absorb water maintaining stability through the life of the fluid. Silicone brake fluid is non-toxic and non-corrosive and will not damage automotive painted surfaces, hoses, seals or other materials. It should be changed according to the manufacturers specifications.

Penrite Silicone DOT-5 Brake Fluid provides excellent braking feel due to stable viscosity over a wider temperature range, does not absorb water, and is safe for paintwork.

Requires all seals, master cylinder plunger and wheel cylinder pistons and housing bores to be in first-rate condition, to prevent leakage at score and corrosion abrades.

Can be used in vehicles that may stand unused for lengthy periods, with compatible rubber seals.

Compatible with most modern brake system materials.

Penrite DOT-5·1 Brake Fluid (Not To Be Confused With DOT-5)

DOT-5·1 brake fluid is a premium quality, full synthetic, non-silicone, DOT-5·1 brake fluid designed for use in a wide range of brake and clutch applications. It can also be used in vehicles with ABS (Anti Brake Skid), AEB (Auto Emergency Braking) and ESP (Electronic Stability Programme) systems where Penrite brake fluid DOT-4 ESP was previously used.

Penrite DOT-5·1 brake fluid is recommended for re-fill or top-up of brake and clutch systems in passenger cars and all other moving vehicle types that require a non-petroleum based brake and clutch hydraulic fluid.

DOT-5·1 brake fluid is suitable for use where either DOT-3, DOT-4, Super DOT-4 or DOT-5·1 fluids are specified. It is also suitable for use with all types of seals, hoses and other brake and clutch system parts. It is suitable for use where lower viscosity fluids (at –40 ºC) are required in colder climatic conditions in the latest ESP, ABS and AEB braking systems with micro valves, that require a lower viscosity and faster circulating fluid to perform correctly.

DOT-5·1 brake fluid can be used for first fill or refilling a brake or clutch system. For best results, the system should always be flushed with Penrite brake fluid DOT-5·1 fluid prior to first fill or before refilling the system. It should be replaced in accordance with the vehicle manufacturer's service schedules.

IMPORTANT: DO NOT mix this product with Silicone DOT-5 or Mineral type brake fluids. Silicone type assembly compounds (lubricants) should not be used in conjunction with this product. Avoid contact with skin, varnish and paint. If skin contact occurs wash with water.

CAUTION: Brake Fluids, types DOT-3, DOT-4 and DOT-5·1, are naturally hygroscopic and will absorb water from the atmosphere. This will lower the effectiveness of the product. After opening a bottle, ensure cap is resealed tightly immediately after use to avoid water contamination.

Further Brake Fluid Information

The Wet And Dry Boiling Points Of Brake Fluid Explained

The terminology of a wet boiling point and a dry boiling point may be confusing. When the DOT rating refers to dry boiling point it means brand new brake fluid straight out of the container. Brake fluid becomes wet when it has been in the system for a period of time and has managed to absorb 3·7% water by volume. Depending on operating conditions, it can take about two years for any DOT glycol-based brake fluid to reach the point where it has absorbed that much water. At that point, the brake fluid will have to be replaced by flushing with new brake fluid. The less humidity the longer the fluid life.

If the brake fluid is allowed to continue absorbing water beyond 3·7% by volume (i.e. leaving it in the braking system for a long time), which it will do if it doesn't get changed, the boiling point will continue to decrease. After reaching about 8% by volume, the boiling temperature will only be around 100 °C. The lower the boiling point of the brake fluid, the less effective it will be. Boiling brake fluid creates air pockets which diminish or completely eliminate the ability of the brakes to actually stop the vehicle from moving. If it gets bad enough, the situation will arise where it is not possible to stop in an emergency. That is why knowing the DOT rating of the brake fluid is important, as well as knowing when it was last changed, and when it needs to be changed again.

What is DOT-5 Brake Fluid Used For?

As we have seen, DOT-5 brake fluid has one of the highest boiling points of all the brake fluids available. Typically, a Jowett can use either a DOT-3 or a DOT-4 brake fluid which are both glycol ether-based brake fluids.

However, DOT-5 brake fluid is a **silicone-based fluid**. This was developed to be used in cars where moisture was definitely going to be prevalent and unavoidable. Most likely for vehicles such as high performance vehicles and military vehicles. It has a very high boiling point, but it also has more

compressibility than the glycol ether-based fluids. Also, there are now DOT-4 brake fluids that have boiling points that are actually above DOT-5 brake fluid so there are not a lot of reasons for changing over to using a DOT-5 fluid for your Jowett if not needed.

The advantage of the silicone based DOT-5 fluid is that it absorbs no moisture whatsoever, unlike the glycol-based fluids. Because it is also chemically inert it will not react with other chemicals in your braking system, nor will it even react to the car's paint which the glycol-based fluids will. For that reason, DOT-5 fluid is also preferred for classic motor cars that don't get driven every day. It can be left to sit in the system arguably for the life of the car without causing any problems.

A DOT-5 silicone brake fluid can be identified at a glance because it is purple, unlike the other brake fluids. DOT-3 is usually yellow or amber while DOT-4 is light blue. DOT-5·1 fluid is usually clear to amber in colour.

Even though, by the specifications, DOT-5 looks like the best brake fluid for an hydraulic brake system based on the boiling point, refer to the information from Penrite for DOT-5 brake fluid.

Problems Associated With DOT-5 Brake Fluid

It seems like DOT-5 brake fluid should be used, since it has the highest boiling point and absorbs no moisture and will not react with everything else in a vehicle. And while that does make it seem good, there are some issues with it as well.

Price – DOT-5 brake fluid is typically more expensive than DOT-3 or DOT-4 brake fluid. This price difference isn't huge, but it is a definite difference between the two types of fluid.

Compatibility – As previously stated, DOT-5 brake fluid cannot be mixed with any other types of brake fluid. Because of the compressibility of silicone-based brake fluids they cannot be used in ABS brakes, because they will not function with quick response.

Boiling Point – Even though the main feature of DOT-5 brake fluid is its high boiling point, it's worth noting that there are other fluids that have higher boiling points that are glycol based. The boiling points for fluids such as DOT-3 fluid and DOT-4 brake fluids shown above, those were the minimum requirements. A brake fluid like Penrite DOT-4 Super Brake Fluid, for instance, is a DOT-4 brake fluid that has a dry boiling point of over 275 °C.

Mixing DOT-4 And DOT-5 Brake Fluids

If the brake system is currently filled with a DOT-3 or DOT-4 brake fluid, it definitely cannot be mixed with DOT-5 brake fluid added to it. Because one is glycol-based and the DOT-5 is silicone-based they will certainly not mix together. The result of adding one to lines filled with the other could be complete brake failure. The fluid will become thick and sludgy in the hydraulic system and will not function as required. Additionally, even if a full flush is carried out, if the vehicle was not designed for DOT-5 silicone-based brake fluid, it could still cause some problems (see note about ABS etc.).

Can DOT-5 Brake Fluid Be Mixed With DOT-5·1 Brake Fluid?

The terminology for this brake fluid can be very confusing due to it sounding similar to DOT-5·1 it is just slightly different from the term DOT-5 brake fluid. However, DOT-5·1 brake fluid has much more in common with DOT-3 and DOT-4 brake fluids. It is also a glycol-based fluid like the other two but does have a similar boiling point to the silicone based DOT-5 fluid.

In general, you can probably safely mix DOT-3 brake fluid with DOT-4 brake fluid or DOT-5.1 brake fluid. Basically, all of the glycol-based fluids are usually interchangeable with one another. It is best to double check with the manufacturer first before mixing them however because when 'usually' is written, it does not mean always and it is possible that they may not compatible with one another. If it is desired to change fluids, it will be necessary to carry out a full system clean out with denatured alcohol and replacing all rubber seals and hoses. Supercheap Auto stock the Blackridge Air Engine Cleaning Gun that features a pointed nozzle that can be used to flush-clean pipes and fittings.

Conclusion

DOT-5 brake fluid is especially good at maintaining efficacy during very high temperatures and is completely immune to water in the brake lines. This makes it an attractive choice for any vehicle owner. DOT-5 brake fluid has been used successfully in Jowett braking systems after fitting rubber components that are compatible with DOT-5 and taking appropriate system cleansing actions.

As with any new fluids that are added to a vehicle, the best course of action is to check the manual before the decision for change to ensure the right fluid in the right quantities are used. The cost of a bottle of DOT-5 brake fluid will cost more than DOT-3 or DOT-4 brake fluids, but the extra cost is not too significant. And, if it is able to last in the brake system for a number of years longer than DOT-3 or Dot-4 brake fluids will, then the extra cost will be amortised due to less fluid flushing and changes, then the change over could be well worth considering.

If the change of fluid type means doing a full system clean and flush, that would be the safest option. Because of the way DOT-5 brake fluid reacts with the glycol-based brake fluids, it is vital to make sure the pipes are completely clean before changing from one type to another, if it is considered as an option for your Jowett motor car, read the warning below.

WARNING!

The question about using DOT-5 Silicone Brake Fluid was discussed with the repair staff at BGT Brake & Clutch Service, in Keysborough and their recommendation was that, if the wheel cylinder seals that suit the Jowett Girling braking system are supplied by them, then the advice was to stay away from silicone brake fluid. The reason for the recommendation was that DOT-5 fluid would swell the rubber seal cups and brake hoses, so, it would be best to stay with DOT-4 brake fluid and flush the system at regular intervals.

The decision for which brake fluid that is used to fill the brake hydraulic system is entirely for the owner and/or repairer to decide.

Brake fluid information sourced from the Penrite Website – with thanks.

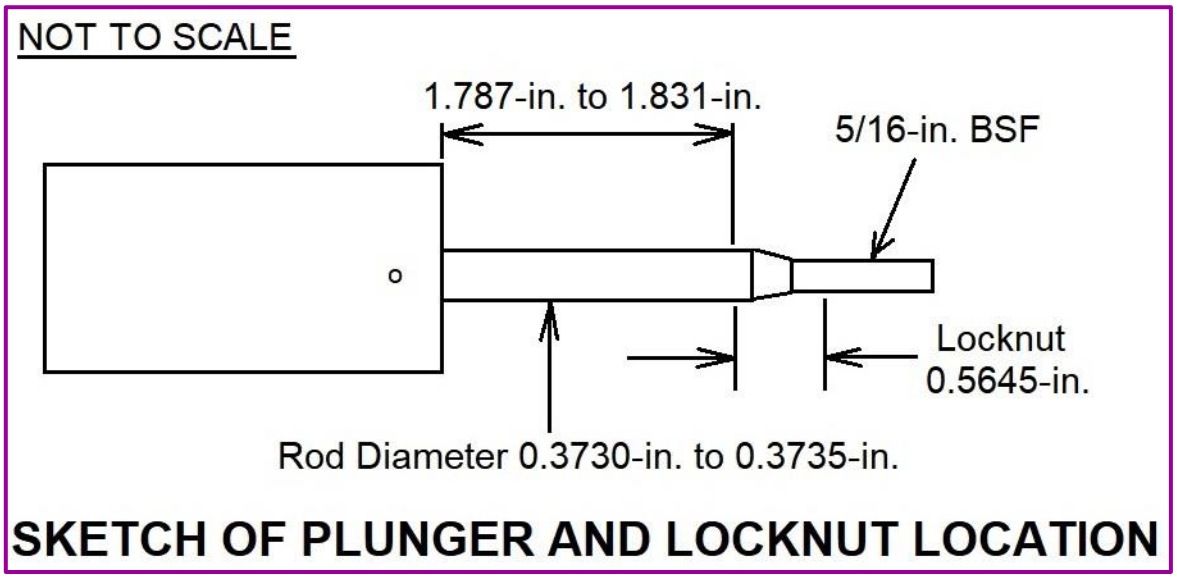
APPENDIX I – Plunger And Rod Inspection

Above: Figure 10. A worn and abused plunger and rod assembly.

Referring to *Figure 10*, '**A**' shows that the rod shank has, at some time, been gripped with pliers. At '**B**' there is indication of scoring due to normal rod movement. Also at this location, there is outer seal rubber residue that has adhered to the rod. At '**C**' there are severe score markings on the outer surface of the plunger. At '**D**', both bleed holes were completely blocked with a black residue. At '**E**' more black residue (quite solid, fully cured sealant?) was found, and was difficult to remove. The example illustrated at *Figure 10*, should be considered as scrap. It appeared that an attempt had been made to block the fluid bleed holes – the reason for such action is, rather puzzling.

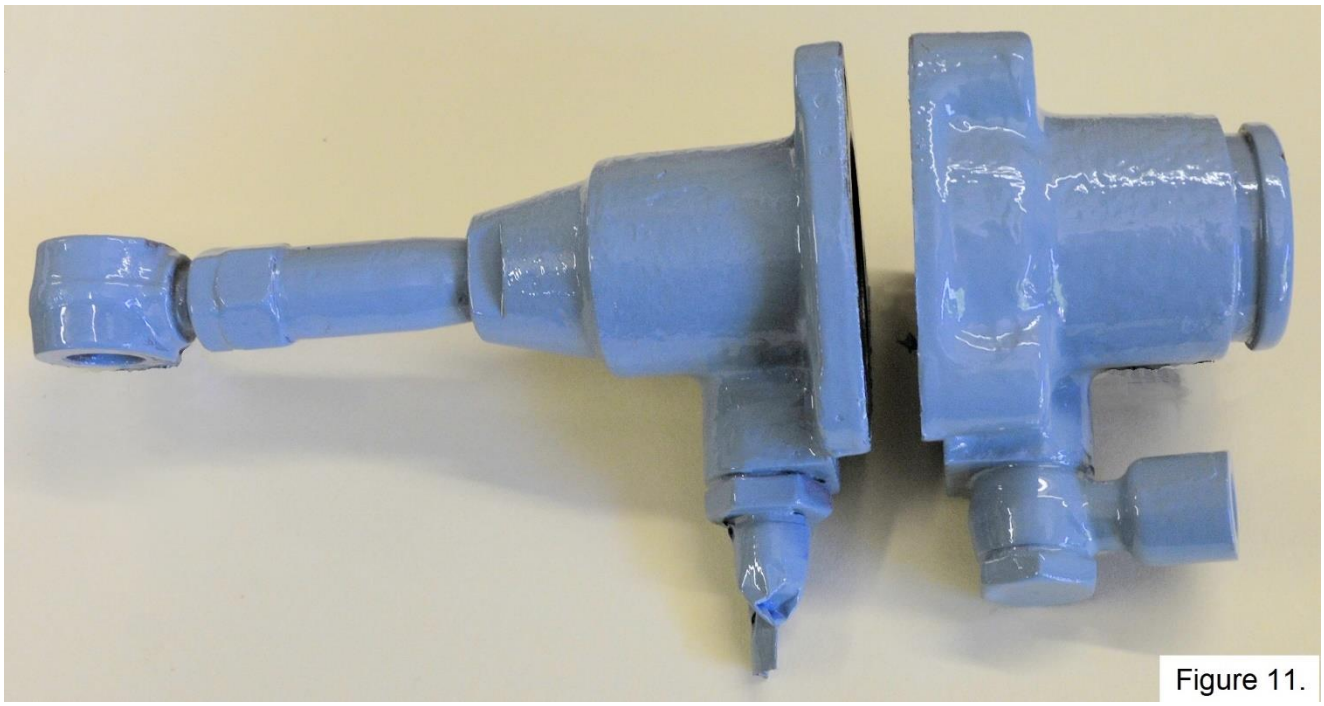
Should a master cylinder's plunger and rod assembly be in suitable condition for re-use, then the two fluid bleed holes should be cleaned with a suitable size drill bit. The holes are of a carefully selected diameter to effectively control the forward and backward flow of brake fluid during foot brake application, release actions along with warming and cooling of the brake fluid. Make sure that there are no burrs at the fluid bleed holes. The hollow area at '**E**', *Figure 10*, must be clean with no lodged debris that can fall into the fluid and create problems. The plunger shown in *Figure 10* was kept in lengthy storage and had been operating with a piece of rubber hose used in place of the outer seal and spreader at 'B' *Figure 10*. Such a repair can be dangerous and, in the event of a fatal accident, may result in extremely serious consequences.

Figure 10 shows a plunger and rod assembly removed from a hydro-mechanical braking system. The foregoing information also applies to the same component from a full hydraulic brake system master cylinder. Should the plunger and rod assembly be replaced, then the support sleeve (*Item 1373*) should also be replaced, the modern replacement parts are of improved quality than the original parts were, with finer machining tolerance controls.



Full-hydraulic For Reference: Dimensions should be noted.
The locknut should be tightened against the taper on the plunger pull rod.

APPENDIX II – Full-Hydraulic Master Cylinder Illustrations



Above: Left, Master cylinder body, rear. Right, master cylinder body, front. Ready for assembly.

Figure 12.

Above: New plunger and rod assembly alongside new PETP support sleeve.

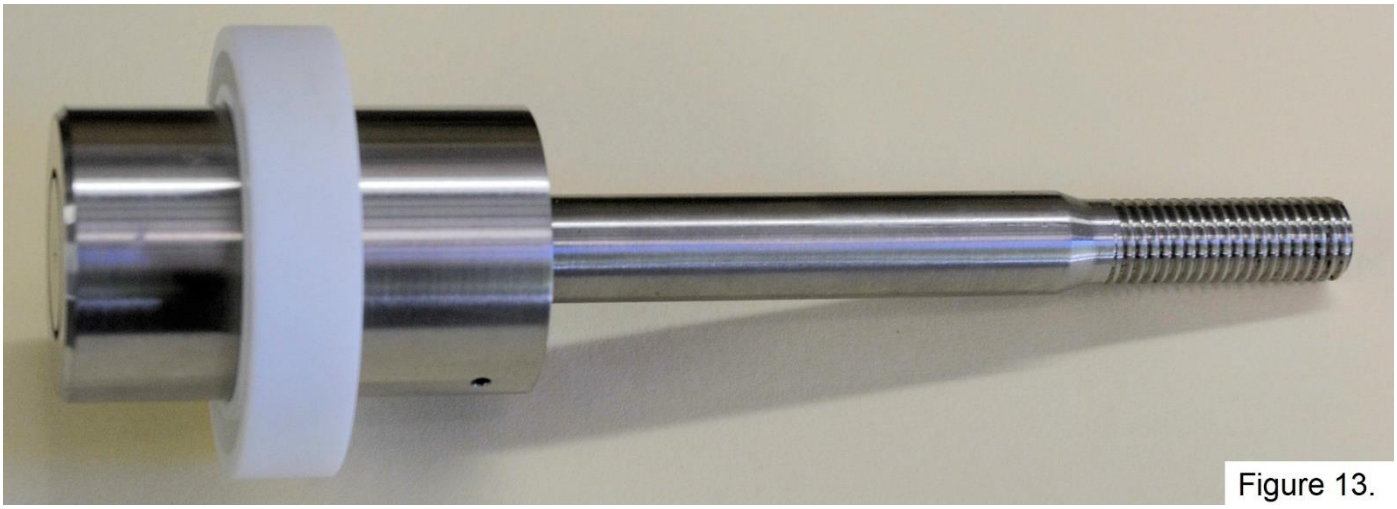


Figure 13.

Above: Support sleeve mounted on plunger.

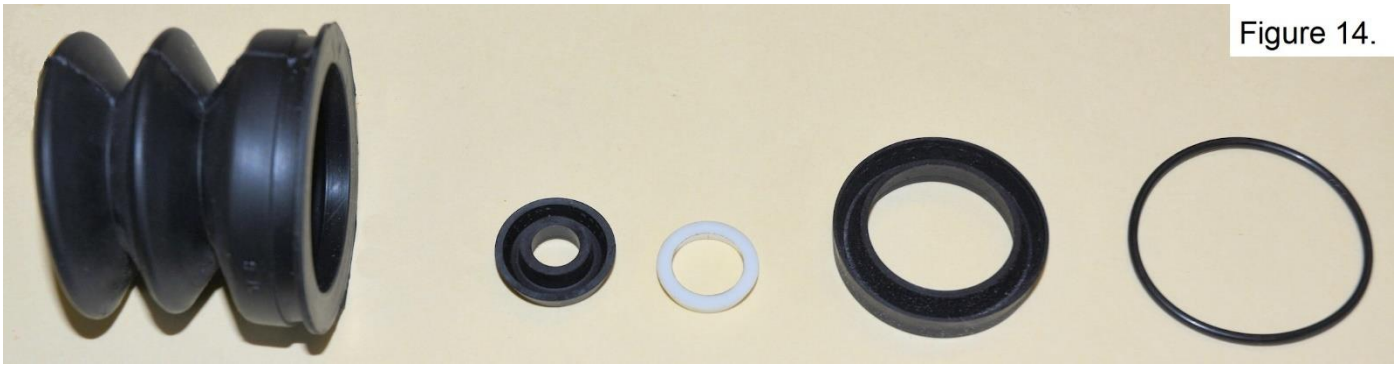


Figure 14.

Above: Components that make up the seal kit.
Left to right: Dust boot, outer seal, outer seal spreader, recuperating seal and body seal ring.

Figure 15.

Above: The assembled master cylinder.

APPENDIX III – Master Cylinder Recuperating Seal Test

After the master cylinder had been assembled during the preparation of these Technical Notes, it became apparent that the fluid flow close-off position at the recuperating seal be determined. So that the actual close-off point could be verified, a test method needed to be developed.

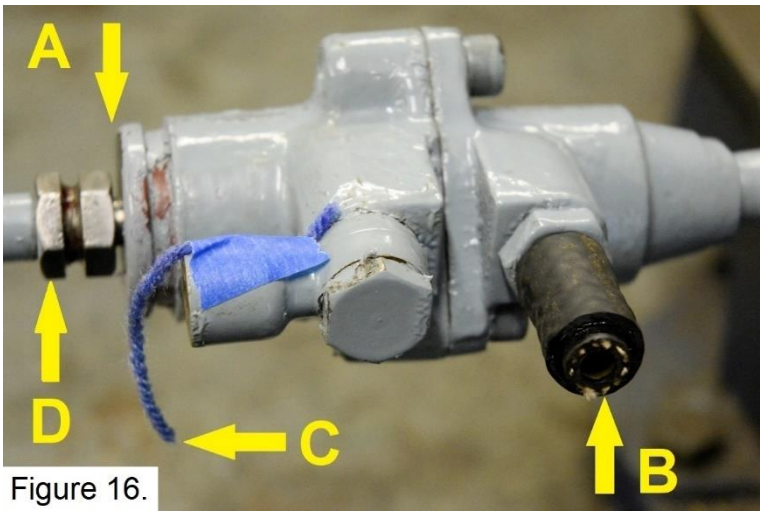


Figure 16.

Right: Figure 16. Method for setting up the master cylinder recuperating seal test.

Referring to *Figure 16*, 'A' shows the gap between the locknut and front body's front face with the plunger in the home position, 'D' is the locknut that has been tightened firmly on the plunger rod, 'B' is a rubber adaptor for an air pressure inlet and 'C' is a piece of floppy knitting wool secured with adhesive tape on the outlet (pressure) fitting. As can be seen, the wool is hanging over the outlet port.

The air compressor was set up using the adjustable paint spray gun pressure control which was set at its minimum air flow setting, with the pressure gauge needle just lifted off its stop. With the gap 'A' at ⅛-in. low pressure air was applied at port 'B', with the plunger in its home position, the air flow lifted the piece of wool 'C' showing air flow through the two drillings in the plunger and between the dimples pressed into the shim (*Item 1374*), into the pressure chamber and out through the hydraulic pipe banjo fitting.

It should be noted that, if the air pressure is too high, then it will bypass the recuperating seal's lips when the drillings in the plunger are covered. The recuperating seal only becomes an effective seal, in the body bore and on the plunger, once pressure builds up in the pressure chamber of the master cylinder and the hydraulic brake pipework. The pressure build up acts on the inner and outer lips of the recuperating seal. The pressure also acts in the same manner on the outer seal (*Item 1381*).

As the plunger rod was drawn forward, the air flow came to a stop. At this point the rod was held against the return spring and the gap measured – it was found to be approximately $^{7}/_{32}$-in. which indicates that the recuperating seal has blocked the flow of air (brake fluid) soon after the brake pedal has commenced brake operation – which is as it should be.

Note: The same procedure can be used for testing the hydro-mechanical master cylinder.

APPENDIX IV – Full-Hydraulic Master Cylinder – Added Information

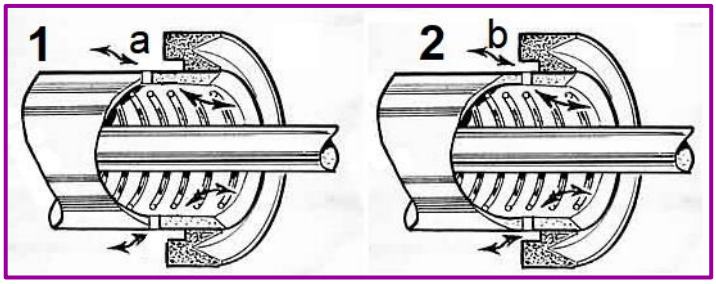
An Update Conversion To Jowett Jupiter Braking System

It has been established that Jupiter Chassis Number E0 SA 42R was originally equipped with the Girling hydro-mechanical braking system. During my ownership, the system has been of the full-hydraulic system. What is not sure is, how and when the conversion to full-hydraulic operation was undertaken. Obviously, the car has had the correct rear axle assembly and front brake assemblies fitted, along with a correct style master cylinder. However, there are some differences that have been observed with regard to the master cylinder installation, the Jowett Spare Parts catalogue is not really helpful – there are different part numbers for components used on Jupiter from those fitted to full-hydraulic Javelin installations.

The master cylinder rear mount eye bracket welded to the chassis main side tube looks correct. On my Jupiter, the brake pedal return spring has always been hooked into the lug shown in *Figure 14*, to the rear of the pedal arm slip clevis. This hook-up has formed a triangle with the sides made up of the master cylinder pull rod assembly, the return spring and the arm on the brake pedal. This has meant that the brake pedal return spring has had no influence on the return of the brake pedal to its home position. All of the return movement has been handled by the plunger return spring (*Item 1378*) since 1962 to my knowledge, maybe some considerable time before that date!

My Jupiter chassis side tube does have a tube welded into it for the hydro-mechanical brake lever pivot. Also, after paint was removed, there was evidence that welded on brackets that facilitated the linkage and its adjustments, as shown for Javelin in *Figure 3*, had been removed and dressed.

Having established that the master cylinder installed in my Jupiter is not a genuine Jowett Girling specified cylinder that allowed the plunger to travel further rearwards to its home position, under load from the plunger return spring, indicates that there was approximately 0·219-in. of plunger travel before the recuperating seal commences to close off flow of fluid from the reservoir to the pressure chamber.



Right: Figure 17. Recuperating seal and plunger relationship with plunger in home position.

Legend – 1 = Non-Genuine; 2 = Genuine.

Referring to *Figure 17*, the recuperating seal to plunger relationship can be seen, it can be noted that should the plunger be allowed to move further rearwards to its home position at '1a', it will have to travel in the forward direction from that position further, to ensure that the fluid bleed holes are completely closed off to brake fluid entering the pressure chamber. This added travel denotes that, as the plunger moves forward, brake fluid will be moved from the pressure chamber through the bleed holes back to the reservoir. This condition is due to the shell of the plunger initially compressing fluid that is static in the pressure chamber, in such a situation the line of least resistance for the fluid is to return to the tank. As soon as the recuperating seal has covered the bleed holes located in the plunger shell, compression of the fluid in the pressure chamber will commence. At this point, the brake pedal will have travelled a significant distance from its home position, to the point where brake fluid commences to be compressed. Such increased movement can give an impression that there is a malfunction within the braking system.

In this instance, with a non-genuine master cylinder, the brake operation can be seen as being in a 'neutral' situation prior to actual brake application. In modern traffic conditions, this delay can be crucial. Extra time is wasted in superfluous brake pedal movement.

It is interesting to note that a new genuine Jowett specification plunger and several seal kits have been installed in the non-genuine master cylinder. Now, I wish that when the 'original' plunger was replaced in 1967, that it had been measured before scrapping it. That could have been revealing!

Right: Figure 18. An experimental bracket and link for the brake pedal return spring.

Consideration was given to performing the recuperating seal test as described in Appendix III on Page 23, after the master cylinder had been installed in the car, in an attempt to measure the amount of brake pedal travel until the air flow is closed-off by the recuperating seal covering the fluid bleed holes. This was deemed to be too difficult, but a simple multiplication of the plunger rod travel and pedal leverage dimension should suffice. The test procedure described, in this instance, was convincing.

In addition to the above-mentioned troubles, it is known that there have been concerns experienced about the plunger return spring not having sufficient strength to push the plunger (*Item 1375*) to its full home position, probably due to swelling of the outer seal (*Item 1381*) and seal spreader (*Item 1383*) or, operating with a lubrication starved plunger rod, also, possibly due to other abnormal mechanical reasons, such as a seized rear eye bolt that cannot pivot. Some have been fitted with an additional assister spring, which if the system has been set up correctly, should not be necessary.

Mike Allfrey – 17th May, 2022.